Entomology

- **Arthropod** → Invertebrate animal with hard chitinized exoskeleton & Jointed appendages



- **Body of arthropod may consists of :-**

ⓐ 3 segments → Insects.
ⓑ 2 ~ → scorpion & spider.
ⓒ 1 segment → Tick & mite.

- **General morphology of arthropod**

① Exoskeleton

- consists of chitin → For hardness & protection.
- It divides the body into 3 segments → Head, Thorax, Body Abdomin

. Each segment consists of :-
① Tergum → Dorsal region.
② sternum → ventral region.
③ pleurons → 2 Lateral regions.

② Integument غشاء

- For production of hairs, scales & spines

③ Digestive system.

- consists of :-

ⓐ **Fore gut** → begin with proboscis (mouth part) → Buccal cavity [contain salivary glands) → pharynx → esophagus → proventriculus
مقدم المعدة

ⓑ **Mid gut** → stores Food & produce enzymes for digestion.

ⓒ **Hind gut** → consists of ilium & rectum

ⓓ **salivary glands** →
→ 2 pairs opening into buccal cavity
→ Labial salivary glands → open into Labium. الشفة
→ Hepatic ceca → 6-8 blind tubes opening at Junction of gizzard (true stomach) & secrete digestive enzymes.

④ Coelom (Body cavity)

- called Haemocoele & contain blood and Lymph (Haemolymph)

⑤ Excretory system

- consists of Malpighian tubules which open into the alimentary canal.

⑥ Circulatory system

- Has primitive tubular heart which has opening called ostia through which the haemolymph enters the heart.

⑦ Respiratory system

ⓐ Tracheal system

- The most common type of respiration
- The air enters trachea through paired Lateral openings in the pleurons called (stigma or spiracles) → then → enter branching system of trachea & tracheoles
- occur in → Adult Flying arthropods
  → Mosquitoes Larvae.

ⓑ Tracheal gills

→ It is closed tracheal system
→ occur in aquatic arthropods

③ Lung books → In spiders

④ Direct cuticular respiration → In mites

⑧ Nervous system

- consists of nerve cord which is connected to supraesophageal ganglion in the brain.

Sensory organs

(a) Eyes

- May be → Reduced → in tick & Lice
  → well-developped → blood sucking Flies

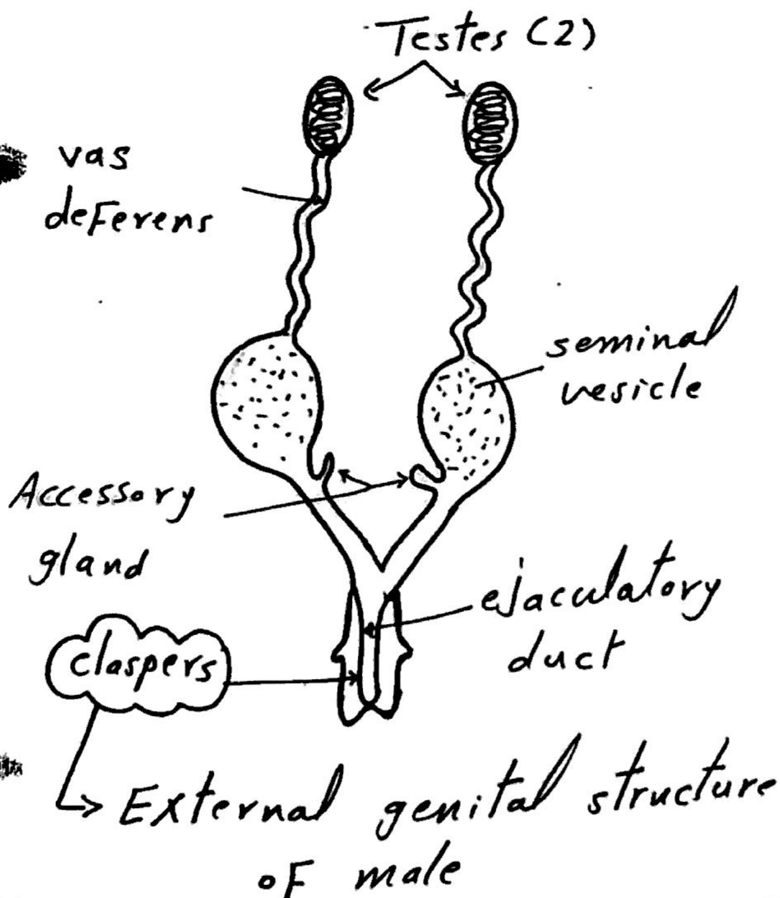
- Female eyes → Dichoptic → separated eyes.
- Male eyes → Holoptic → very close together

- ocelli → are simple eyes present on the top of Head.
  → Differentiate Light From dark

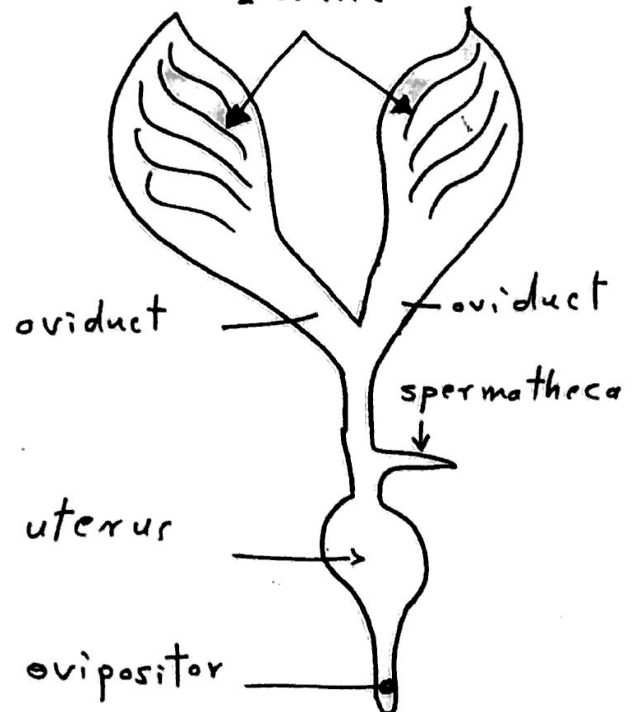
(b) Antennae
(c) palps
(d) Hairs

(9) Genital system

Male genital system



Female genital system



Development of arthropods

- Female may be
  - → oviparous → Lay egg ex → Musca domestica
  - → viviparous → Lay Larva ex → Sarcophaga
  - → pupiparous → Lay Larva ready to pupate at once ex → GLossina

- After mating → oviposition occur in suitable breeding site from humidity & temperature.

- Young insect when hatch From egg may be :.

ⓐ Ametabolic insect → Resemble their adults
ⓑ Metabolic insect → Differs From their adults & require to undergo Metamorphosis

- **Metamorphosis** → Morphological & developmental changes which occur to the hatched insect (metabolic) to resemble their adults

① Holometabola (Complete Metamorphosis)	② Hemimetabola (Incomplete Metamorphosis)
There is complete change in morphology & Feed habits of Larva From adult	The hatched Larva resemble their adults except in:- ⓐ size ⓑ absence of reproductive organs
Egg —hatch→ Larva —moult→ pupa (→ enclosed, → Non-Feeding) —shed skin→ Adult	Egg → Larva → Nymph → Adult.
Ex → Flies, Mosquitoes & Fleas	Ex → tick, mite, lice & cockroaches

veterinary Medical importance of arthropods

① Arthropod as direct agent of disease or discomfort

① Entomophobia → Fear from insect
- Animal is excited when hear sound of insect (Mosquitoes, oestrus ovis) & doesn't Feed.

② Accidental injury to sense organs → when insects enter eyes or ears

③ Envenomization → some arthropods secrete poisons from poisonous glands.

④ Dermatosis or skin irritation due to mechanical bite of mosquitoes & Flies.

⑤ Allergy & sensitivity to insect secretions → saliva of arthropods has irritant substances.

⑥ Myiasis

② Transmission of disease agents

Ⓐ Mechanical transmission

- May be

① **Internally** → Arthropod swallow the pathogen which pass through the alimentary canal in Feces without change.

- Ent. Histolytica → By Musca domestica
- Tryp. evansi → ~ tabanus & stomoxys
- Tryp. equinum → ~ ~ ~

(b) Externally

→ Through contamination of external body surface of arthropod (legs, wings, proboscis) by pathogen.

- Neither multiplication nor development occur.

(B) Biological transmission

- The pathogen multiply and/or change (develop) to another form.

(1) propagative transmission → The pathogen ↑ only in number without development inside the arthropod vector.

- Endemic typhus → Lice
- plague → Fleas

(2) cyclodevelopmental → The pathogen inside vector undergo cyclic development without ↑ in number

- Filarial worms in mosquitoes.

(3) cyclopropagative → The pathogen inside the vector undergo cyclic development & ↑ in number

- plasmodium species → in mosquitoes.
- Leishmania ~ → ~ sand Fly.
- Trypanosoma ~ → ~ Glossina.

(4) Transovarian → As cyclopropagative but → The pathogen transmitted through ovaries of adult ♀ vector to its offsprings.

- Babesia Bigemina → By hard tick.

(Arthropoda)

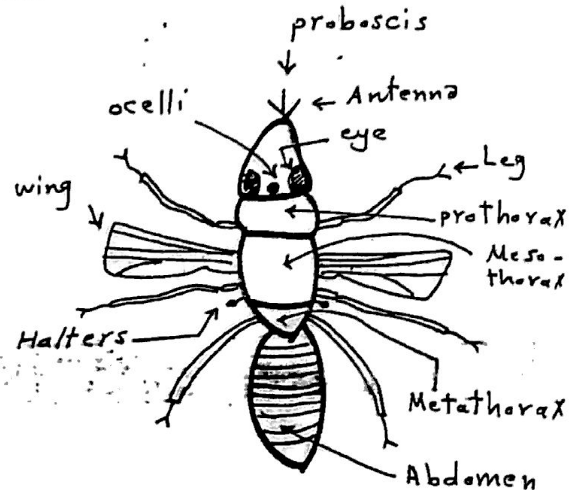
① Insecta ② Arachnida ③ crustacea ④ Myriapoda ⑤ pentastomida

① Insecta = Hexapoda = Antennata

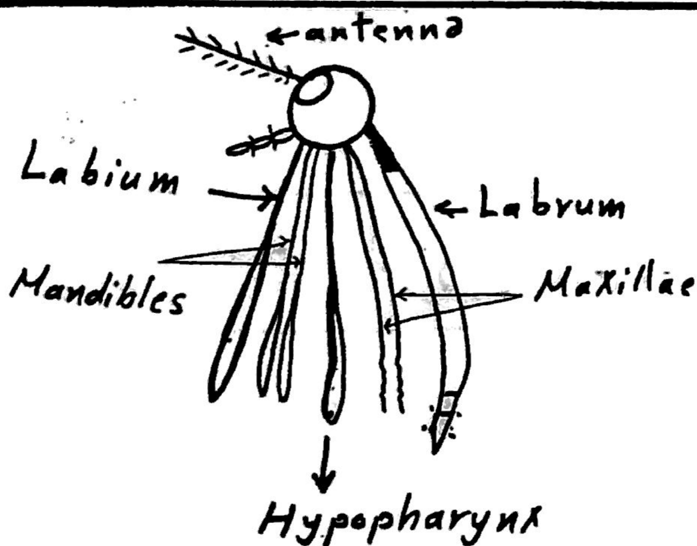
General characters

① Head

- consist of 6 fused segments
- **Head carries** → pair of eyes
  → pair of antennae
  → proboscis (Mouth part)



- Basic structure of proboscis



① → Labrum (upper Lip)
② → Jaws → paired maxillae
  → " Mandibles
- Maxillae may carry maxillary palps which are sensory for food.
③ → Hypopharynx → similar to tongue.
④ → Labium (Lower Lip) → May carry sensory Labial palp

- **Food channel** → Formed by Hypopharynx & Labrum
- **proboscis may be adapted for** → Biting & chewing
  → piercing & sucking
  → sucking only

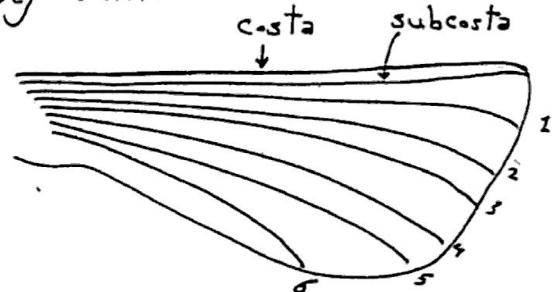
② Thorax

- **consists of 3 segments** → prothorax
  → Mesothorax
  → Metathorax
  } Each segment has pair of Jointed Legs

- Thorax → In some insects → Has 2 pairs of wings
  → In Diptera → Has → pair of Functional wings
    → pair of reduced wings (Halters)
  → In Fleas, Lice & bugs → wing-Less

- Functional wings → Arise From mesothorax & supported by 6 hollow tubes called wing veins

- Halters → small knob-like sensory structure
  → Has balancing Function



③ Abdomen

- consists of up to 11 segments
- The Last (terminal) segment is modified to form the external genitalia → In ♀ → ovipositor.
  → In ♂ → claspers.

Classification of Insecta

- ① Diptera → Mosquitoes & Flies
- ② siphonaptera → Fleas
- ③ phthiraptera → Lice
- ④ Hemiptera → Bugs
- ⑤ orthoptera → cockroaches & Grass hoper
- ⑥ coleoptera → Beetles & weevils
- ⑦ Hymenoptera → Ants, Bees, & wasps.

Diptera

- classified into

	Nematocera	Brachycera	cyclorrhapha
size	small (only ♀ parasitic)	Large (♀ parasitic)	medium (♂ & ♀ parasitic)
Antenna	Long, hairy & 15 segments	3 segments	3 segments & arista
maxillary palp	4 - 5 segments	2-3 segments	1 segment
wing	No cross veins	cross veins	Limited cross veins
emergence From pupa	From T-shape opening (orthorrhapha)	→ The same	From circular opening at anterior end through ptilinal sac [cyclorrhapha)
Egg	Laid in water	on shallow water	Laid on ground
Larva ↳ Head	well-developped - Aquatic	ill-developped Aquatic	poorely-developped. - Terrestrial - Maggot-like
pupa	obtectate → Free ↳ mobile - Aquatic	- obtectate - Aquatic.	- coarctate → Not Free ↳ Non-mobile -Terrestrial

Ⓐ Nematocera

→ ① culicidae
→ ② psychodidae
→ ③ ceratopogonidae
→ ④ simulidae

Ⓐ Suborder: Nematocera

① Mosquitoes (culicidae)

Antenna → 15 segment
- ♀ → pilose → Fine, short ha
- ♂ → pulmose → dense, Long ~

- Abdomen → 10 segments

- proboscis → ♀ Adapted For piercing & sucking.
- ♂ → Non-parasitic & Adapted For chewing
  - → Mandibles & Maxillae → Reduced

(٢٠٠٠) ٢(٢٠٠٦)

Med. Imp. of Mosquitoes

1- Nocturnal Feeding & painful

2- Act as vectors For

Ⓐ Anopheles

1- Malaria of Man.
2- Filaria of dog
3- Fowl spirochaeta
4- Equine Encephalomyelitis-

Ⓑ Culex & Aedes

1- Malaria of Birds
2- Filaria of Dogs
3- ~ ~ Man

Culex
- → Fowl spirochaeta
- → African horse sickness

Aedes → Yellow Fever
- → Equine Encephalomyelitis
- → Rift valley Fever

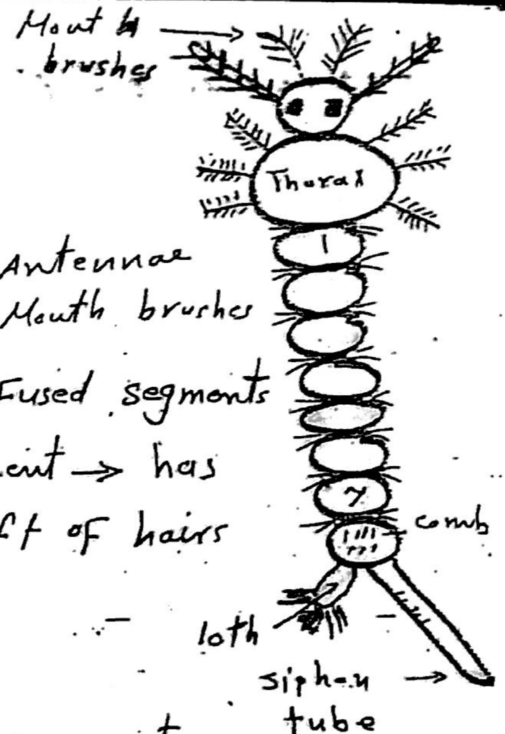
Larva of Mosquitoes

Worm-like
- wing-Less
- No Legs

(Head) → 2 Antennae
→ 2 Mouth brushes

(Thorax) → 3 Fused segments

Each segment → has Lateral tuft of hairs



Abdomen

- 10 segments
- 1st 7 segments → similar

8th segment
↳ has → siphon tube
↳ comb.

- 9th segment → Reduced

- 10th segment (Anal segment) →

Carries anus which surrounded By → 4 papillae
→ Anal grills.

Item	Anophilini (Anopheles).	Culicini → Culex. → Aedes.
Adult (1) position	Rest with angle to surface	Rest parallel to the surface
(2) Maxillary palp → ♀	Long as proboscis Antenna → piLose ♀	short than proboscis. ♀ Antenna → piLose.
→ ♂	Long as proboscis Bulbed. Antenna → pulmose. ♂	Long as proboscis Not - bulbed. Antenna → pulmose. ♂
(3) scutellum	curved (monoLobed) Hair	TriLobed
(4) Wing	Brown spots on costal margin	Non-spotted.
Egg	Laid singly & Boat-shape Has paired Lateral fLoats	**cuLex** - Laid in rafts (50-200) - Has floating apparatus (micropyl) at one pole. **Aedes** . Laid singly - No Float.

Item	Anopheles	culex & Aedes
Larva		
Resting position	Rest parallel to water surface Feed on materials present on water surface	Hangs head down from water surface & feed below water surface.
siphon tube	Absent but has respiratory spiracles on 8th abdominal segment.	present → culex → Tubular → Aedes → Barrel-shape.
Comb	Absent	present (7th, 7th) → culex → several rows. → Aedes → single row.
palmate hair	on dorsal surface of abdomen.	Absent
Pupa		
Respiratory trumpets	short, broad & funnel-shape. cephalo-thorax Abdomen → 8 segments paddle-like extensions.	Long & narrow ← Respiratory trumpts cephalo-thorax Abdomen → 8 segments

Life cycle of Mosquitoes

- → Anopheles.
- → culex.
- → Aedes.

Although mating occur in the air → The other developmental stages are aquatic.

Adult ♀ (oviparous) ← (نكتب أي منهما في الجدول)
(After mating & Blood meal)

→ Lay eggs on water surface →

(مهم جداً)

up to 300 Egg
- Single → Anopheles.
  → Aedes.
- Egg raft → culex

→ Hatching several days or weeks →

(مهم الجدول)

Larva (Aquatic)
- undergo 4 instars
- Feed on organic matter.
- Respirate atmospheric air by → spiracles → Anopheles
  → siphonal tube
  → culex.
  → Aedes.

→ After one week to several months →

pupa (Aquatic)

(مهم جداً)

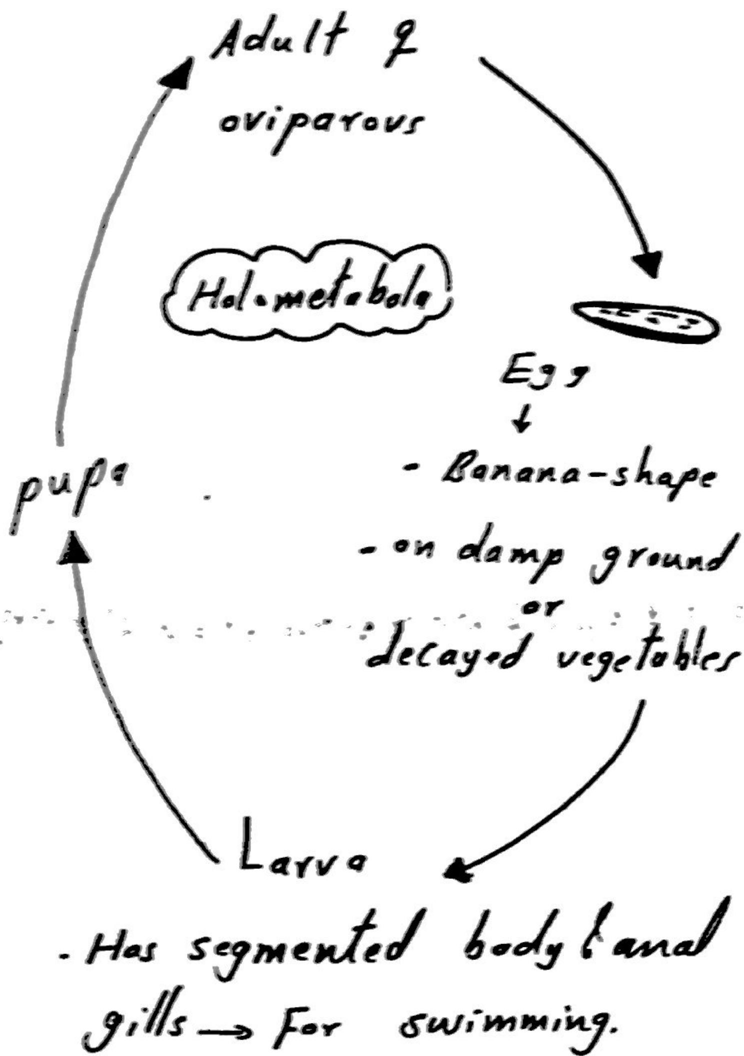
- → Respiratory trumpts
  - → Short & Broad → Anopheles
  - → Long & narrow → culex.
    → Aedes.
- → Motile.
- → comma-shape.

→ Adult emerge from T-shape opening (orthorrhapha) →

complete metamorphosis

	Family: ceratopogonida ② (Biting midges) (culicoides)	Family: psychodidae ③ [Sand Fly = Hairy Fly = phlebotomus]
Morph.	small 2 mm short Legs Has humped thorax	small 5 mm Long Legs Has humped thorax & hairy appearance. Has Large black eyes
Antenna	Long 15 segments ♂ → pulmose ♀ → piLose	Long 16 segments & beaded.
wings	Mottled & held at rest in form of closed pair of scissors	Lanceolated & covered by hairs at rest → erected over the body
proboscis	For piercing & sucking only ♀ blood sucker - Hanged vertically	→ same → same - Recovered on both sides
Med. imp.		

Life cycle of Culicoides



- Has segmented body & anal gills → For swimming.

Med. imp

① Fly in groups → Annoyance to animals & Man.

② sweeting itch on withers of Horse.

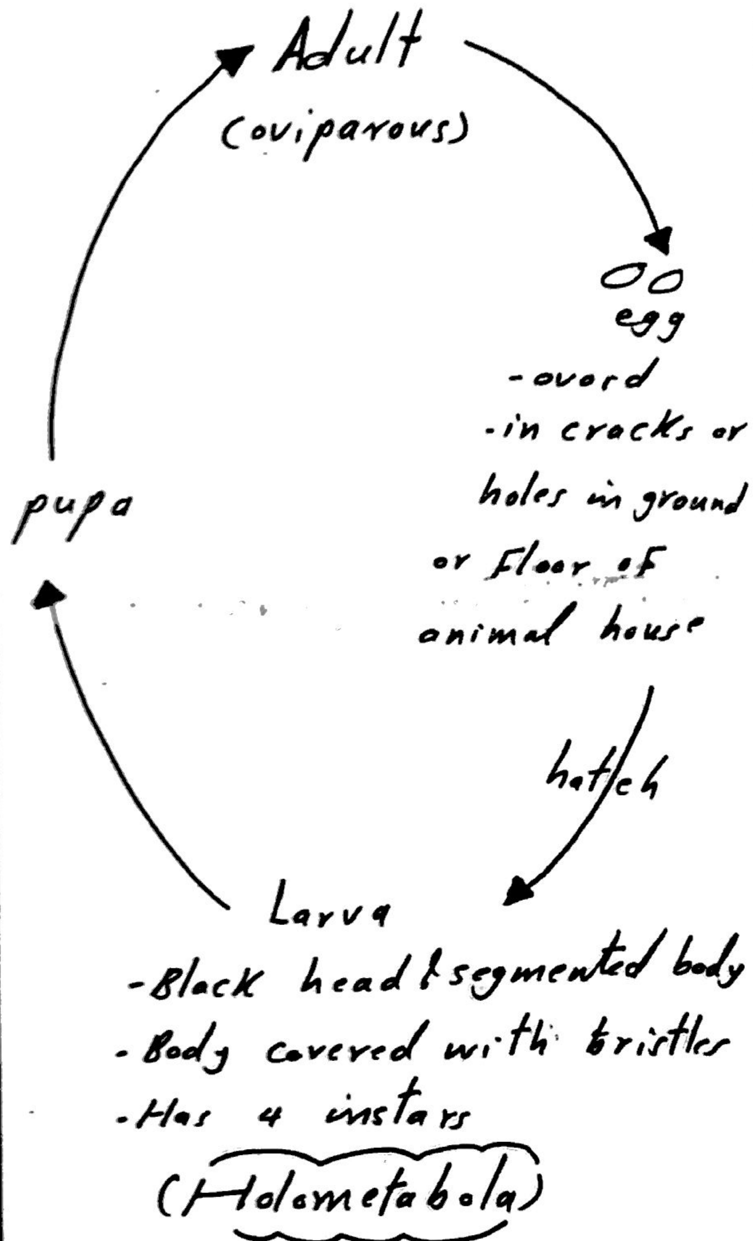
③ Transmission of :-

① Blue tongue

② African Horse sickness

③ Filaroid nematode [onchocerca]

Life cycle of Sand Fly



- Black head & segmented body
- Body covered with bristles
- Has 4 instars

(Holometabola)

Med. imp.

① Female → Blood suckers

② Transmission of Leishmania

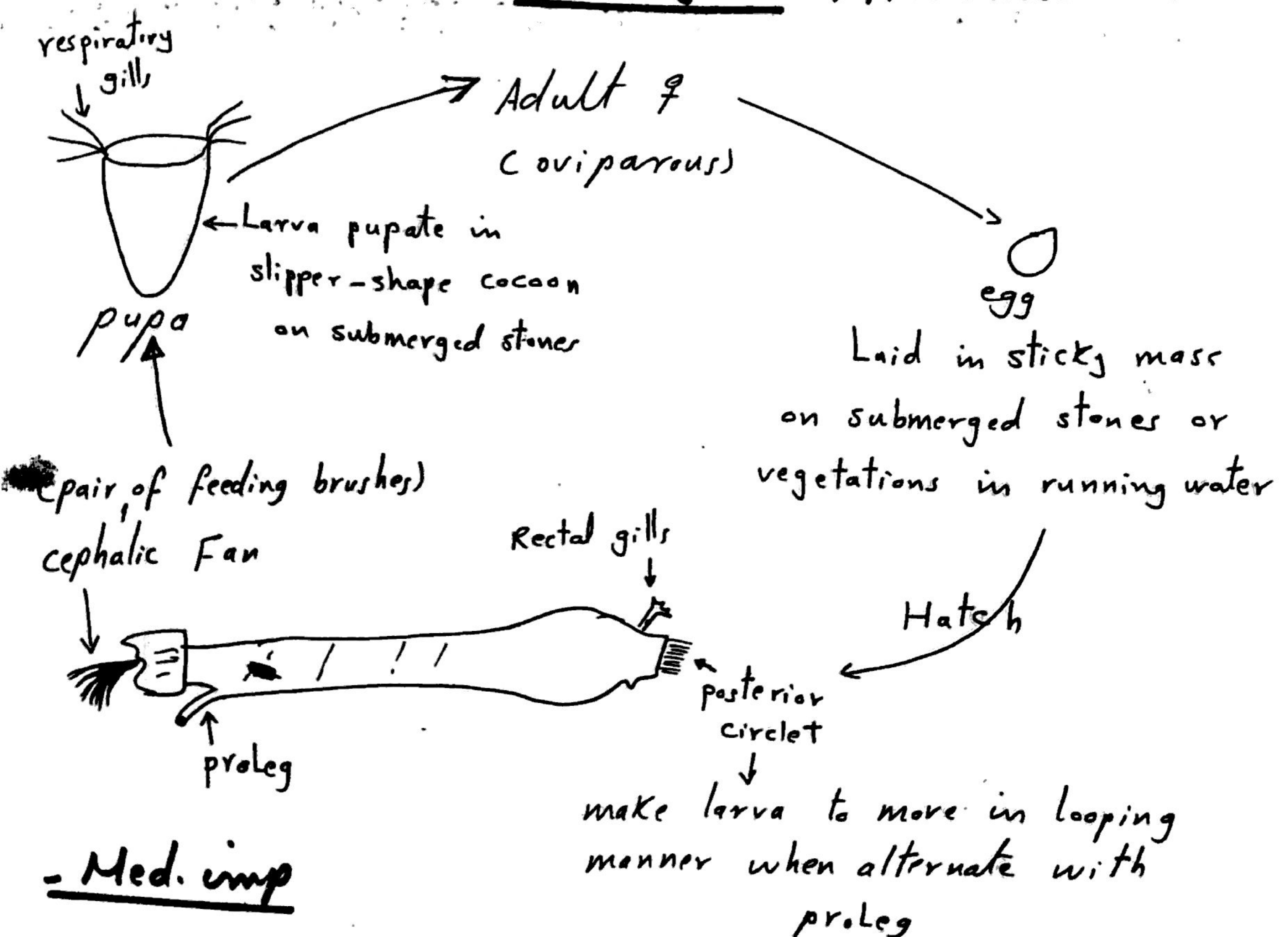
- L. tropica
- L. donovani

④ Family: simulidae

simulium = Black Flies = Buffalo gnats

- Morph → small, Black Flies
  - Has Humped thorax
- proposcis → Adapted For piercing & sucking
  - only ♀ → Blood suckers.
- Antenna → 11 segment without hairs.
- Abdomen → segmented

Life cycle → Holometabola



- Med. imp

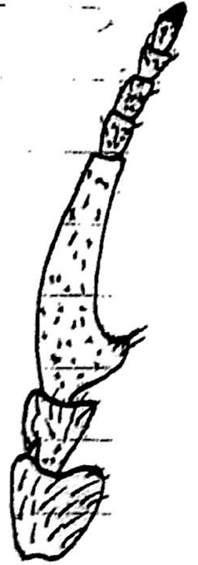
- Transmit → onchocerca
  - → Avian leukocytozoan.

(B) Suborder : Brachycera

Family : Tabanidae.

(1) Genus : Tabanus = Horse fly = Gad Fly

Morphology


(Antenna)

→ Large & yellowish to brown in Calour.
→ Large Eye → ♂ → Holoptic.
→ ♀ → Dichoptic.

→ Antenna → Consists of 3 segments
- 3rd segment → Largest
↳ subdivided into 4 segments due to annulations

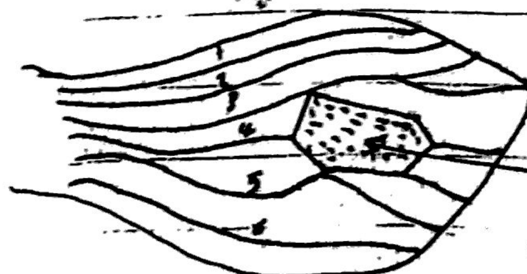
→ Mouth part → Adapted For piercing & sucking.

→ Maxillary palp → consists of 2 segments

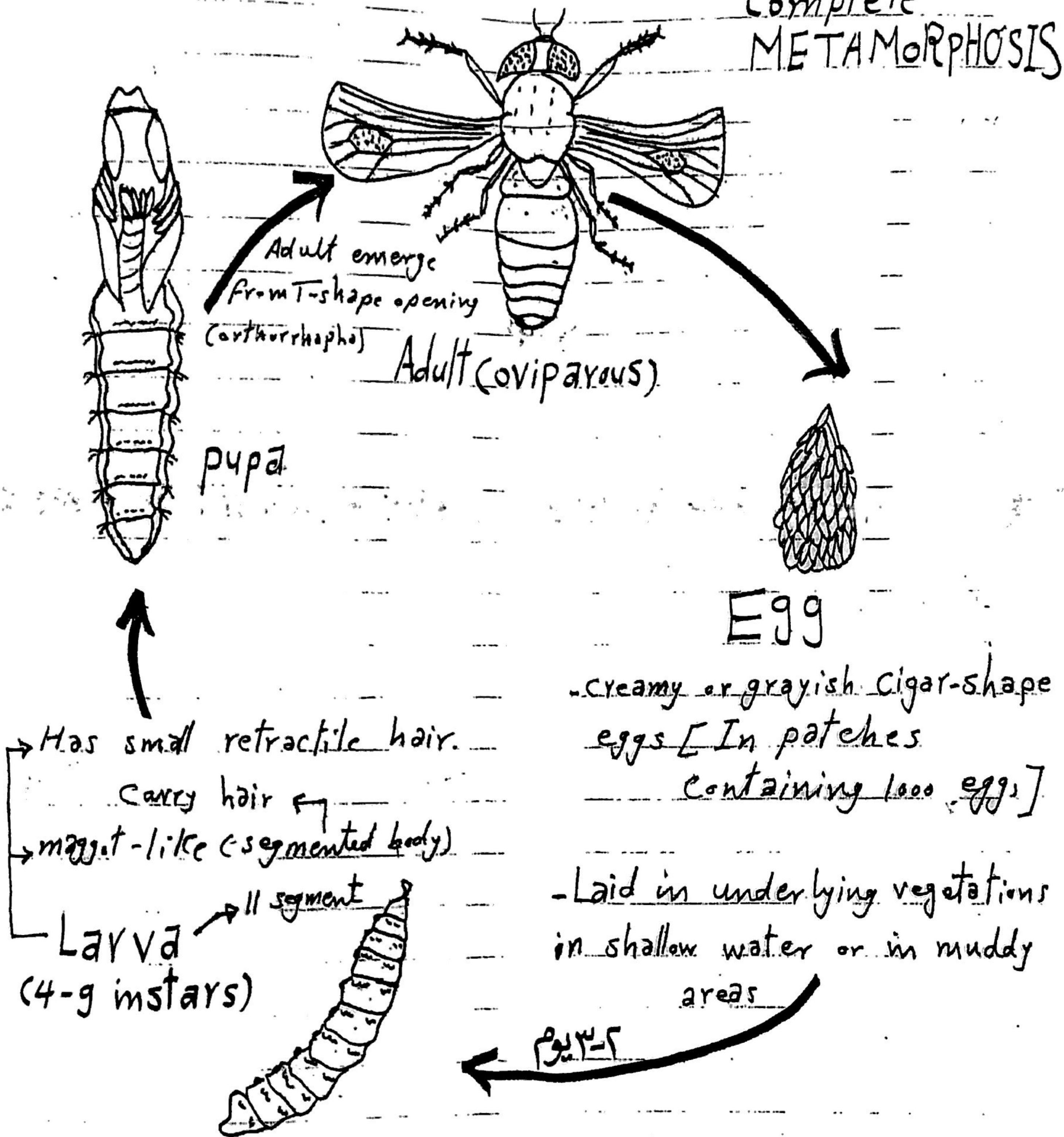
→ Thorax → Has Longitudinal dark strips (|||)

→ Abdomen → consists of 7 segments & has dark Longitudinal strips over yellow background.

→ WING → Large & characterestic
- 1st, 2nd & 6th veins → Are single (Non-branched)
- 3rd, 4th & 5th veins → Are branched & Form DisCal cell. (HeXagonaL)


Discal cell (Hexagonal)

Life cycle of tabanus



Medical Importance of tabanus

1- Adult → Active during mid sun light (Diurnal) → Attack the animals by very painful bite → ↓ Food Intake → ↓ productivity.

2- Transmission of disease agents.

(A) Mechanical transmission

- → Tryp. evansi.
- → Tryp. equinum.

(B) Biological transmission.

- → Trypanosoma theileri in cattle.

(C) Act as vector For
- → Anthrax bacilli
- → Equine Infectious Anemia virus.

(2) Genus: chrysops (Deer Fly)

- similar to tabanus except
  - a) Has dark bands across the wings.
  - b) Has coloured eyes.
  - c) Antenna → 3 Joints
  - d) Importance → act as I.H For human filaria (Loa Loa)

(3) Genus: Haematopota.

- similar to tabanus but has Mottled wing.